September 20, 2005

International file reference: PCT/EP2004/013547
Applicant name: Hübner Elektromaschinen AG

New description introduction

Apparatus for the detection of movements and/or positions of an object

Technical field

The invention relates to an apparatus for the detection of movements and/or positions of an object, in which a voltage pulse is in each case produced as a function of the movements and/or positions of the object in at least one coil, by means of at least one magnetic field which carries out a relative movement with respect to the coil and acts on it, with the coil at least partially surrounding a spring which is composed of magnetically permeable material and carries out a reciprocating movement under the influence of the magnetic field, on the basis of the reluctance effect.

Prior art

An apparatus of the above type in the form of a tachometer is known from US 2003/094945 A1. In the known apparatus, three Reed contacts are distributed over the circumference of the circular path of a revolving magnet which is oriented tangentially with respect to the circular path, which Reed contacts each comprise a glass ampoule into which two sprung contact tongues, whose ends overlap, are fused. When the magnet approaches one of the Reed contacts, its magnetic field thus passes through the contact tongues, leading to an

increase in the magnetic field as it approaches closer. When the magnetic field reaches a specific strength, the forces of attraction between the contact tongues overcome their spring forces, and the ends of the contact tongues move towards one another suddenly. The closing of the contact between the contact tongues results in a rapid change in the magnetic field, which generates a voltage pulse in the coil surrounding the respective Reed contact. The aim of this is to ensure that sufficiently strong signals for electronic evaluation are obtained even at low rotation speeds.

A signal which is generated by a sudden change in a magnetic field is also obtained with an apparatus as is known from US 6,249,118 B1, in which the end of a plunger, which is in the form of a pole shoe of a magnet, interacts with teeth on a toothed wheel.

In addition to the apparatuses that are already known, and in which the magnetic field of in each case a single magnet generates a voltage pulse in at least one coil, apparatuses are also known in which two magnets are in each case used to generate voltage pulses. For example, DE 102 19 303 C1 discloses an apparatus in which the moving object is formed by a hollow shaft on which a magnet supporting arm is mounted such that it can pivot and is fitted with two magnets of opposite polarity which are offset with respect to one another in the direction of the longitudinal axis of the hollow shaft. Coils are arranged at a distance from the shaft and over the circumference of the shaft and supply voltage pulses to an evaluation unit under the influence of the fields of the magnets passing them. The coils are held by webs which form coil cores and connect magnetically permeable ring segments to an outer ring which surrounds the ring segments and the

coils and is likewise magnetically permeable. Further ring segments are arranged between the ring segments to which the coils are fitted, are separated from them by a gap, and are likewise connected to the outer ring. The width of the gaps between the ring segments in this case corresponds essentially to the width of the magnets. The described configuration of the known apparatus means that a rapid pivoting movement of the magnet support arm takes place in the area of the gaps between the ring segments when the shaft is rotating at slow speeds and, as a consequence, this leads to production of a strong voltage pulse in the coils.

Finally, DE 43 42 069 A1 discloses an apparatus with two opposite-polarity magnets, the first of which carries out a movement in synchronism with the object. A second magnet of opposite polarity is associated with this first magnet and is located at one end of a leaf spring, whose other end is attached to a fixed holder. The second magnet is arranged above the movement path of the first magnet. When the first magnet approaches the second magnet during slow movements, the latter is repelled because of its opposite polarity and the leaf spring is deformed, leading to an accumulation of potential spring energy in it. Since the restoring force of the leaf spring increases as the deflection increases, a deflection position is reached, as the movement of the first magnet progresses, at which the restoring force of the leaf spring is greater than the repulsion forces between the first and the second magnet, resulting in the leaf spring springing back, dissipating the potential energy accumulated in it. In order to convert

the kinetic energy released as the leaf spring springs back to an electrical pulse, a coil which has an iron core is provided on the side of the second magnet facing away from the path of the first magnet. The magnetic flux which passes through the iron core of this coil is changed in a very short time during the backward movement of the second magnet, so that a voltage pulse is induced in the coil.

Description of the invention

The aim of the invention is to induce voltage pulses which are as large as possible in a coil, using simple means, in particular when an object is moving slowly.

The stated object is achieved in a first embodiment of the invention in that the magnetic field is produced by a magnet pair comprising two adjacent magnets of opposite polarity, which are arranged one behind the other in the direction of movement of the object and whose longitudinal axes, in the same way as the longitudinal axis of the coil, are oriented essentially at right angles to the movement direction of the object, and in that the reciprocating movement of the spring causes a polarity change, which produces the respective voltage pulse, in the magnetic field in the coil.

The apparatus according to the invention is distinguished by a surprisingly simple, compact and maintenance-free design. In this apparatus, the respective leading magnet drives the free end of the spring with it, since the lines of force of this magnet search for the path of least magnetic reluctance, based on the reluctance principle. When the magnet is moved further, then a state is reached in which the restoring

force of the spring overcomes the magnetic driving force and the spring moves into the area of the lagging magnet, of opposite polarity, by which it is absorbed with additional acceleration. This means that the spring suddenly reverses the polarity of the magnetic field acting in the coil thus resulting in a strong voltage being produced in the coil surrounding the spring. In general, this remagnetization also takes place at higher speeds of the object when the two adjacent opposite-polarity magnets which form a magnet pair move quickly past the spring, without the spring being able to carry out any significant movements in this case, because of its inertia.

A second solution to the stated object consists in that the magnetic field is produced by a magnet pair whose magnets are arranged alongside one another when viewed in the direction of their relative movement with respect to the coil, with both the pole surfaces of the magnets and that end surface of the leaf spring which faces the pole surfaces of the magnets being essentially in the form of rectangles, whose longitudinal axes include an angle α of less than 60° with the tangent to the movement path of the magnets, and in that the reciprocating movement of the spring causes a polarity change, which produces the respective voltage pulse, in the magnetic field in the coil.

The alternative solution has a further advantage in that force or torque pulsations are reduced to a negligible level. Pulsations such as these have a disturbing effect in the case of the first embodiment of apparatuses in the form of tachometers when the aim is to monitor the rotation speed of relatively small drives.

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New claims 1 and 2

1. An apparatus for the detection of movements and/or positions of an object, in which a voltage pulse is in each case produced as a function of the movements and/or positions of the object in at least one coil, by means of at least one magnetic field which carries out a relative movement with respect to the coil and acts on it, with the coil at least partially surrounding a spring which is composed of magnetically permeable material and carries out a reciprocating movement under the influence of the magnetic field, on the basis of the reluctance effect, **characterized in that** the magnetic field is produced by a magnet pair comprising two adjacent magnets (6, 7) of opposite polarity, which are arranged one behind the other in the direction of movement of the object (1, 24, 32) and whose longitudinal axes, in the same way as the longitudinal axes of the coil (4), are oriented essentially at right angles to the movement direction of the object, and in that the reciprocating movement of the spring (5) causes a polarity change, which produces the respective voltage pulse, in the magnetic field with respect to the coil (4).

2. The apparatus as claimed in the precharacterizing clause of claim 1, **characterized in that** the magnetic field is produced by a magnet pair whose magnets (44, 45) are arranged alongside one

another when viewed in the direction of their relative movement with respect to the coil (52), with both the pole surfaces of the magnets (44, 45) and that end surface of the leaf spring (46) which faces the pole surfaces of the magnets (44, 45) being essentially in the form of rectangles, whose longitudinal axes include an angle (α) of less than 60° with the tangent to the movement path (48) of the magnets (44, 45), and in that the reciprocating movement of the spring (46) causes a polarity change, which produces the respective voltage pulse, in the magnetic field in the coil (52).

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1. An apparatus for the detection of movements and/or positions of an object, in which a voltage pulse is in each case produced as a function of the movements and/or positions of the object in at least one coil, by means of at least one magnetic field which carries out a relative movement with respect to the coil and acts on it, with the coil at least partially surrounding a spring which is composed of magnetically permeable material and carries out a reciprocating movement under the influence of the magnetic field, on the basis of the reluctance effect, **characterized in that** the magnetic field is produced by a magnet pair comprising two adjacent magnets (6, 7) of opposite polarity, which are arranged one behind the other in the direction of movement of the object (1, 24, 32) and whose longitudinal axes, in the same way as the longitudinal axes of the coil (4), are oriented essentially at right angles to the movement direction of the object, and in that the reciprocating movement of the spring (5) causes a polarity change, which produces the respective voltage pulse, in the magnetic field with respect to the coil (4).

2. The apparatus as claimed in the precharacterizing clause of claim 1, **characterized in that** the magnetic field is produced by a magnet pair whose magnets (44, 45) are arranged alongside one

another when viewed in the direction of their relative movement with respect to the coil (52), with both the pole surfaces of the magnets (44, 45) and that end surface of the leaf spring (46) which faces the pole surfaces of the magnets (44, 45) being essentially in the form of rectangles, whose longitudinal axes include an angle (α) of less than 60° with the tangent to the movement path (48) of the magnets (44, 45), and in that the reciprocating movement of the spring (46) causes a polarity change, which produces the respective voltage pulse, in the magnetic field in the coil (52).